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COOLING LUBRICANT FOR METAL MACHINING OPERATIONS

Hans-Georg Lutz

Foreign Technology Division
Wright-Patterson Air Force Base, Ohio

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COOLING LUBRICANT FOR METAL MACHINING OPERATIONS

by

H. Lutz

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Aq. solns. of heavy metal salts contg. cations acting as corrosion inhibitors, mixed with org. bases, are useful as coolants in chipping or hobbing metal pieces. Mixts. of heavy metal salts 3 to 6, $NaNO_2$ 0.2 to 0.3, polyalcs. or ethers 5 to 20, org. bases 3 to 10 and H_2O 88.8 wt. percent may be used. Thus, a mixt. of $NiSO_4$ and $7H_2O$ 3, $NaNO_2$ 0.2, polyethylene glycol mono et ether 10, Et_3N 5, and H_2O 81.8 percent was used as a coolant in metal cutting. Veb Schmierstoffkombinat Zeitz [AA1100639]

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COOLING LUBRICANT FOR METAL MACHINING OPERATIONS

By: H. Lutz

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Cooling lubricant for metal machining operations

This invention concerns a supplementary material to increase the service distance or service life of cutting tools such as millers, drills, lathe cutters, punches, etc., and steels coated with wear-reducing cutting materials.

It is well known that in various cases the cutting ability of tools with geometrically defined cutting edges can be increased by supplementary measures. For instance, with high-speed steel tools, such measures include nitriding, hard-chroming, hot steam treatment, phosphatizing, inchromizing, sparking, sulfidizing, carburizing, plasma spraying, etc. Cooling lubricants are also often used.

As active components, these contain aqueous or oil-based systems of salts, particularly alkaline earth and alkali metal salts, soap-salt mixtures, such as borax-sodium soap, or glycols, alcohols, and other water-miscible liquids.

Along with soaps and alkalis, used primarily in water solution, cooling lubricants based on fatty acids, esters, and metal soaps are used. The decrease in friction and wear here results from reaction with the metallic material being worked.

The use of these materials is limited with respect to their thermal resistance. They are surpassed by cooling lubricants consisting of oil-soluble compounds containing in particular the elements Cl, B, and P.

The use of corrosive solutions, such as inorganic acids, has also been described previously for metal machining. In particular, the solutions should have a pH value of 1 to 3. The pH should be maintained independent of concentration variations by use of buffered solutions. For example, acids forming difficultly soluble

heavy metal and calcium salts are used, with heavy metal or alkali salts of the same acids as buffer salts. The heavy metal and alkali metal salts mentioned also have the function of maintaining the pH value within the cited limits.

It is known that an electrolytic layer of lead can be deposited on milling tools during the milling operation by use of an external current source. This layer is continuously worn away, but is continuously reformed, and decreases the cutting wear.

All the measures mentioned have the disadvantage that only a very limited increase in service life or service distance or in the work productivity can be attained.

The thermal resistance of aqueous cooling lubricants is limited. This causes narrow limits of application in respect to the working pressure. That is, the working rate and cutting force are limited.

Oils, in contrast, have a considerably less heat dissapation capacity than aqueous solutions. In most cases, corrosive solutions of inorganic acids are only partial solutions. Used as cooling lubricants, these solutions produce inacceptably high corrosion and are poorly compatible with many machine parts. Due to the inadequacy mentioned, expensive aftertreatment is usually needed. Furthermore, the tools must often be subjected to additional and sometimes very expensive treatment before use. Coatings applied before the tool is used wear relatively fast, so that the tool must be regenerated after a relatively short time.

With galvanic depositing of lead coatings onto milling cutters during milling, an additional external current source is needed. Also, conduction of the current to the rotating tool is expensive and unsafe.

The purpose of this invention is to increase the service distance or life of cutting tools, to increase the working productivity in milling, the improvement of the surface finish of the machined workpiece, and to obtain better ability to mill materials which are hard to mill.

The invention is based on the problem of attaining this object by an appropriate auxiliary material flowing onto the cutting tool, which is capable of forming friction and wear decreasing layers under the conditions prevailing in milling, and which compensates for the injurious electron flows which occur, without having a negative effect on the other functions of the auxiliary material.

It was found that, among other things, the service distance or life could be increased several times and the working productivity increased by use of aqueous heavy metal electrolyte solutions without external current sources, or by use of metal electrolyte solutions in which the metallic components show characteristic properties of the heavy metals.

The electrolyte solution should flow steadily with a full stream onto the cutting tool being used.

To improve the action, e. g., to increase the wetting ability and to protect the machine, tool, and work piece from corrosion, appropriate known additives, such as surface-active materials and inhibitors, are added.

One cooling lubricant which proves suitable consists of 3-6 % by weight of a heavy metal salt, or of a metal salt in which the metallic component shows characteristic properties of the heavy metals, 0.2 - 0.3 % by weight of water-soluble nitrite, 5 - 20% by weight of polyalcohols and their ethers, 3 - 10% by weight of organic bases, and up to 88.2% by weight of water.

The advantage of the invented solution is particularly that it is possible to attain a multiple of the service distance or service life in comparison to that with the measures previously

known. This decreases tool costs. Further, a more rational milling of difficult to machine or up-to-now non-machinable materials is possible. No additional cost is necessary, as the electrolyte solutions can be directed to and away from the tool like the known cooling lubricants. There is an increase in the working productivity with the same service distance or service life, and corresponding increase in the cutting or feed rate.

The invention will be explained in more detail by several examples:

Example 1:

In hobbing C 60 with a hobber 80 mm in diameter (10 teeth) and using an electrolyte solution of the following composition by weight:

3% nickel sulfate · 7 H_2O
0.2 % sodium nitrite
10 % ethyl polyglycol
5 % triethanolamine
81.8% water (pH 8 - 9)

roughing cuts were made at a cutting speed of 35 m/min, a depth of 3 mm, and a width of 40 mm, with a feed rate of [1]
The average wear on the cutter after a service distance of 30,000 mm was 0.3 to 0.4 mm.

Example 2:

In hobbing C 60 with a high-speed steel, twice the service distance could be attained at about three times the cutting rate by use of an ordinary commercial nickel electrolyte containing 38-42 grams nickel per liter, 8-10 g chloride per liter, 16-18 g boric acid[2] per liter and a pH value of 4 - 4.5 at a working temperature of 20-60°C.

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(1) Translator's note: illegible
(2) Translator's note: German Bohrsäure (drilling acid) changed to Borsäure (boric acid).

The cutting velocity increased from 17 m/min to 70 m/min for the usual cutting depth of 3 mm for conventional service distances (15,000 mm).

The same cutting conditions resulted in complete destruction of the cutter after a cutting distance of 600 mm when the usual soluble oil emulsions were used as cooling lubricants.

Patent Claims:

1. Use of aqueous heavy metal electrolyte solutions or solutions of metal salts for which the cations, combined with work materials, have heavy metal character with respect to wear behavior, without external current sources, as cooling lubricants for metal machining operations.

2. A heavy metal electrolyte solution according to Claim 1, characterized by the fact that it consists of

3	to	6	% by weight of heavy metal salt
0.2	to	0.3	% by weight of sodium nitrite
5	to	20	% by weight of polyalcohols and their ethers
3	to	10	% by weight of organic bases
and up to		88.8	% by weight of water.

3. A heavy metal electrolyte solution according to Claims 1 and 2, characterized by the fact that it has the following preferred composition:

3	% by weight of nickel sulfate · 7 H_2O
0.2	% by weight of sodium nitrite
10	% by weight of ethyl polyglycol
5	% by weight of triethanolamine
81.8	% by weight of water